DETERMINANTS OF FINANCIAL DISTRESS IN LARGE FINANCIAL INSTITUTIONS: EVIDENCE FROM U.S. BANK HOLDING COMPANIES

I INTRODUCTION

In recent years many large U.S. financial institutions have failed or came close to failing due to their lending practices and trading behaviour (Allen, Babus and Carletti, 2009; Laeven, 2011). Such failures have triggered a sharp contraction in both advanced and emerging economies, and the government rescues associated with these failures have given rise to substantial fiscal costs (Laeven and Valencia, 2012). These events highlight the critical importance of understanding the determinants of financial distress of large financial institutions in the promotion of financial stability.

Studies of financial stability tend to belong to one of two highly related areas of research: bank default/insolvency risk, and the effect of various factors on bank risk taking. Default/insolvency risk is the uncertainty surrounding a firm's ability to serve its debts and obligations (Crosbie and Kocagil, 2003). There are two commonly used measures to detect default/insolvency risk: the Distance-to-Default (DD) and Z-Score measures (Miller, 2009), both of which are negatively related to financial distress. Meanwhile, the recent 2007-2009 financial crisis has given rise to a plethora of studies investigating the various determining factors on bank failure or bank risk taking, including Demirgüç-Kunt and Huizinga (2010), Houston et al. (2010),

Beltratti and Stulz (2012), Cole and White (2012), Berger and Bouwman (2013), and Berger, Imbierowicz, and Rauch (2014).

Recent studies such as Avraham, Selvaggi and Vickery (2012) suggest that almost all U.S. banking assets are controlled by bank holding companies (BHCs). Therefore, it would be helpful for academia, practitioners and financial regulators to have a deep understanding of financial stability when examining the determinants of large financial institutions' default risk with reference to BHCs. However, despite the advanced stage of research on various aspects of BHCs[1], few studies investigate what drives financial distress of BHCs, and the implications for financial regulation.

In this paper, we use a sample of 629 selected BHCs with 15503 observations of firm-quarters from 2003Q1 to 2013Q4 to investigate the effects of various factors on financial distress in terms of default risk in large U.S. BHCs. We use both the DD and the Z-Score as dependent variables to predict financial distress. To detect various determining factors derived from the literature in the field in both crisis times and normal times, we follow Berger and Bouwman (2013) in their formal definition of the recent 2007-2009 financial crisis. As a result, our sample is divided into three periods based on Berger and Bouwman (2013): before the crisis, i.e. 2003Q1-2007Q2; during

[1] Recent studies of the general issue of BHCs can be found, for example, in Avraham, Selvaggi and Vickery (2012), Copeland (2012), Cetorelli, Mandel and Mollineaux (2012) and Adams and Mehran (2003). Other studies that examine a variety of aspects of BHCs include Ashcraft's (2008) investigation of whether bank holding companies are a source of strength to their banking subsidiaries. Curry, Fissel and Hanweck (2008) assess whether BHC risk ratings are asymmetrically assigned or biased over the business cycles. Elyasiani and Wang (2010) examine the relation between asymmetry of BHCs and their non-interest income diversification. Cornett, McNutt and Tehranian (2009) probe the impact of corporate governance on earnings management in the U.S. BHCs. Studies on BHC diversification include Elyasiani and Wang (2012) and Goetz, Laeven and Levine (2013).

the crisis, i.e. 2007Q3-2009Q4; and after the crisis, i.e. 2010Q1-2013Q4. We apply our empirical model to test our hypotheses for each of the three periods separately.

Our main findings are as follow: (1) The housing price index is always a statistically significant determinant and is positively associated with both the DD and the Z-Score before, during and after the recent financial crisis, implying that as a proxy for a pro-cyclical macroeconomic condition, a sharp decline in house prices may tend to drive financial distress. (2) Of our two selected measures of BHC risk characteristic, the non-performing loan ratio is the most powerful indicator predicting default/insolvency risk among all the selected independent variables before, during and after the crisis, while the other measure, short-term wholesale funding, can be considered a reliable default risk indicator, particularly when using DD to predict financial distress. (3) Concerning the two alternative measures of BHC activity diversification, i.e. non-interest income and off-balance-sheet activities, non-interest income (NIN) has a directly positive effect on insolvency risk within all selected periods when using Z-Score to predict financial distress, while when using DD as the dependent variable, we find the negative effect of NIN on default risk only during the crisis time; off-balance-sheet activity has a directly negative impact on Z-Score only before the crisis, whereas it has a negative impact on DD after the crisis, and no impact on DD or Z-Score during the crisis. (4) Of the three measures of regulatory capital requirement, i.e. Tier I leverage ratio, Tier I capital ratio, and Tier 1 risk-based capital ratio, all have a directly positive impact on both DD and Z-Score only after the crisis, i.e. 2010Q1-2013Q4.

Furthermore, because of data permission, we add an important corporate governance variable, institutional ownership, into our main econometric model to conduct a robustness test as our additional analysis, based on the recent trend whereby many studies suggest that corporate governance plays an important role in bank risk taking (see such as Laeven and Levine, 2009; Pathan, 2009; Erkens, Huang and Matos, 2012; Beltratti and Stulz, 2012; Berger, Imbierowicz and Rauch, 2014). After adding this corporate governance variable, our main findings still hold. Our additional analysis also indicates that there is a strongly positive relationship between institutional ownership and both the DD and the Z-Score during the crisis time, which is contradictory to the previous evidence reported in Laeven and Levine (2009) and Ellul and Yerramilli (2013) that banks with more institutional ownership take more risk. We argue that a possible explanation for our results on institutional ownership may be that during crisis periods institutional shareholders are always prudent and reluctant to take more risks. Hence, if they are willing to take on more shareholdings of a certain BHC during the crisis, this risk-taking action seems to imply that these institutional shareholders think the BHC in which they are investing has a better financial soundness.

Our study contributes to the literature in several ways. First, this paper extends the existing BHC literature, by examining various determining factors on default/insolvency risk of large U.S. BHCs using both the DD and the Z-Score separately as our dependent variables for predicting financial distress in the selected periods: before, during, and after the crisis. Second, as detailed in part C of Section 5,

our main finding can provide some implications for financial regulation, which can help us to thoroughly understand, and evaluate, current policies such as the Dodd-Frank Act of 2010.

The remainder of the paper is organized as follows. Section 2 reviews the literature on bank risk. Section 3 develops the hypotheses that we will examine and specifies our econometric formulation. Section 4 discusses the data and provides conventional descriptive statistics. Section 5 presents the empirical findings, conducts additional analysis and identifies possible policy implications. Section 6 concludes.

II THE BANK RISK LITERATURE

Studies investigating bank default/insolvency risk and the effect of various factors on bank risk taking have been well documented. The two commonly used measures to detect default/insolvency risk for predicting financial distress are Distance-to-Default (DD) and the Z-Score. The DD is a market-based measure for gauging how far a firm is away from default, originally derived from the models of Black and Scholes (1973) and Merton (1974). These original models have been extended to investigate various bankruptcy-related problems (for recent review studies, see Sundaresan, 2000; Jarrow, 2009; Sundaresan 2013). The Z-Score, as an alternative measure, explicitly compares buffers, i.e. capitalization, and returns and risk, i.e. volatility of returns, to detect a bank's insolvency risk. A higher Z-Score denotes greater stability of the bank. Studies employing the Z-Score measure to investigate bank stability include Boyd and Runkle (1993), Berger, Klapper and

Turk-Ariss (2009), Laeven and Levine (2009), Demirgüç-Kunt and Huizinga (2010), Houston et al. (2010) and Beltratti and Stulz (2012).

The recent financial crisis triggered a series of studies that investigate the effect of various factors on bank risk taking. For example, Demirgüç-Kunt and Huizinga (2010) employ a sample of 1,334 banks from 101 countries before the 2008 financial crisis to investigate the effect of bank activity and short-term funding strategies on bank risk and return. They find international evidence that banks that rely heavily on non-interest income and non-deposit funding activities tend to be very risky. Based on a sample of nearly 2,400 banks from 69 countries, Houston et al. (2010) investigate the relationship among creditor rights, information sharing and bank risk taking. Their findings show that stronger creditor rights enhance the probability of financial risk, and that information sharing can be helpful not only to improve bank profitability and economic growth, but also to lower bank risk and the probability of financial crisis. Based on a sample of large banks across the world during the period 2007-2008, Beltratti and Stulz (2012) investigate the determinants of bank performance, finding that the better-performing banks had less leverage and lower returns immediately before the crisis. Cole and White (2012) investigate the determinants of U.S. commercial bank failures during the recent financial crisis, and find that the CAMELS[2] components and measures of commercial real estate investments play an important role in causing the bank failures that occurred during 2009. After formally

[2] CAMELS is an acronym for Capital adequacy; Asset quality; Management; Earnings; Liquidity, and Sensitivity to market risk.

defining the 2007-2009 financial crisis in the US, Berger and Bouwman (2013) investigate the effect of capital on a bank's performance. Their results show that, for small banks, capital can help them to improve their market share and probability of survival at all times; and for medium and large banks, capital can improve their performance mainly during financial crisis.

However, recent studies such as Avraham, Selvaggi and Vickery (2012) suggest that as almost all U.S. banking assets are controlled by bank holding companies (BHCs), it would be helpful for us to gain a deep understanding of financial stability if we are to examine the determinants of large financial institutions' default risk from a BHC perspective. Although various issues regarding BHCs have been researched, there are few studies examining the determinants of default risk in BHCs, a very important issue that can provide critical insights on how to improve the regulation of a key segment of the financial sector. In this light, we investigate the effects of various factors driving the movements of distance-to-default as proxy for default risk to find the determinants of financial distress in large U.S. BHCs.

III HYPOTHESIS DEVELOPMENT AND MODEL SPECIFICATION

A. Hypothesis Development

Based on the literature in the field, we construct the following four hypotheses:

1. *The Business Cycle Hypothesis (H1): As a pro-cyclical macroeconomic factor, housing prices are positively related to both the DD and the Z-Score of BHCs.*

In this hypothesis, the default risk is associated with the macroeconomic state of the economy. Following Blundell-Wignall and Roulet (2012), we use housing prices

as the proxy. Their study shows that, in the country location of the assessed bank, housing prices have the property to capture business cycles driving asset prices.

2. *Risk Characteristic Hypothesis (H2): Indicators of BHC risk characteristics such as the non-performing loan ratio and short-term wholesale funding are negatively related to both the DD and the Z-Score of BHCs.*

Existing studies have investigated the impact of a BHC's risk characteristics on its default risk, performance, or executive compensation. Bennett et al. (2012) find that higher levels of non-performing assets/total asset ratio are negatively associated with the DD measure. Balboa, López-Espinosa and Rubia (2012) probe whether the factor causing increases in systemic risk in the banking industry, i.e. short-term wholesale funding, could arise from the desire of bank managers to increase their variable compensation, and find that this factor is positively related to high levels of variable compensation. Balboa et al. (2012) also suggest that short-term wholesale funding is unstable, which can be taken to imply interconnectedness among financial institutions and exposures to liquidity risk. In the light of these findings, our hypothesis employs both BHC risk characteristics, i.e. non-performing loan ratio and short-term wholesale funding, to investigate whether these factors can affect DD and Z-Score.

3. *Capital Requirement Hypothesis (H3): BHCs' capital requirement measures, including the Tier I Risk-Based Capital Ratio, Total Risk-Based Capital Ratio, and the Tier I Leverage Ratio, are positively associated with both the DD and the Z-Score of BHCs.*

A U.S. BHC needs to report three separate capital ratios to the regulator: Tier 1 risk-based capital ratio, Total risk-based capital ratio, and Tier I leverage ratio, whereby the regulator determines whether the bank is well-capitalized, adequately

capitalized, or under-capitalized[3] (Kisin and Manela, 2013). In our hypothesis, we use these three regulatory capital ratios as the alternative capital requirements to test the relation between them and both the DD and the Z-Score.

4. *Activity Diversification Hypothesis (H4): The diversified activities of BHCs such as those reflected in non-interest income or off-balance-sheet activity are negatively associated with both the DD and the Z-Score of BHCs.*

Over the last two decades, the activities of financial institutions have diversified considerably, shifting from the traditional (borrowing and lending) toward related activities, e.g., proprietary trading and private OTC market-making services (Flannery, 2012). Many studies have examined various aspects of BHC activity diversification. Some related studies investigate the issue of non-interest income. For example, Stiroh (2004) reports that between 1984 and 2001, non-interest income, i.e. the revenue associated with trading and advising activities, grew from 25% to 43% of total revenue of U.S. commercial banks. Related studies are Stiroh and Rumble (2006) and Brunnermeier, Dong and Palia (2012). Other researches probe the issue of banks' off-balance-sheet activity. Minton, Williamson and Stulz (2005) investigate whether the use of credit derivatives by U.S. BHCs can reduce bank risk, and find that this seems not to increase the soundness of the banks involved. Li and Marinč (2013) assess the effect of financial derivatives on the systematic risk of publicly listed BHCs

[3] According to Kisin and Manela (2013), a bank is regarded as well-capitalized if both of the following are true:

a. Core capital (leverage) ratio ≡Tier 1 (core) capital as a percentage of average total assets - ineligible intangibles ≥ 3% to 5% depending on its composite CAMELS rating;

b. Tier 1 risk-based capital ratio ≡ Tier 1 (core) capital as a percentage of risk-weighted assets ≥ 6%; Total risk-based capital ratio ≡ Total risk-based capital as a percent of risk-weighted assets ≥ 10%.

in the U.S., and find that greater use of credit derivatives reflects higher systematic credit risk. Deng and Elyasiani (2008) employ the ratio of notional principal on interest rate contracts to total assets as the measure of off-balance-sheet activity risk for their hypothesis testing. In our hypothesis, we use the non-interest income ratio and off-balance-sheet activity as alternative measures of BHC activity diversification to test the linkage between them and both the DD and the Z-Score.

B. Model Specification

For our model specification, we first identify our dependent variable. We use the Distance-to-Default (DD) and Z-Score measures as our dependent variables to investigate default/insolvency risk of financial institutions, and apply them separately. For the DD measure, we use the KMV-Merton model based on Black and Scholes (1973) and Merton (1974). The assumption of the Merton model suggests that the market value of assets A_t follows a random log-normal process expressed by:

$$\Delta A_t / A_t = \varepsilon\left(\mu_A \Delta t, \sigma_A \sqrt{\Delta t}\right) \qquad (1)$$

where μ_A is the expected return and σ_A is the volatility of assets. According to the Black-Scholes pricing of call options, the value of equity E_t at any time t prior to the maturity can be written as:

$$E_t = A_t N(d_1) - L e^{-r(T-t)} N(d_2) \qquad (2)$$

where r is the risk-free rate, L is the book value of the firm's debt, and T is the maturity time. The terms d_1 and d_2 are calculated by:

$$d_1 = \frac{\ln\left(A_t / L\right) + \left(r + \frac{1}{2}\sigma_A^2\right)\left(T - t\right)}{\sigma_A\sqrt{T-t}} \qquad (3)$$

$$d_2 = d_1 - \sigma_A\sqrt{T-t} \qquad (4)$$

The Black-Scholes pricing in (2) can provide the linkage between the volatility of equity and the volatility of assets through Ito's Lemma:

$$\sigma_E = \left(\frac{A_t}{E_t}\right) N(d_1)\sigma_A \qquad (5)$$

The Merton model implies that the current value of assets A_0 and its volatility σ_A can be derived from the two equations (2) and (5) with $t = 0$.

As a result, the distance-to-default (DD), the number of standard deviations away from the default point, can be given by:

$$DD = \frac{\ln\left(A_0 / L\right) + \left(\mu_A - \frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}} \qquad (6)$$

A bank defaults or is bankrupt when $DD = 0$.

For the Z-Score measure, we follow the related studies such as Berger, Klapper and Turk-Ariss (2009), Laeven and Levine (2009), and Demirgüç-Kunt and Huizinga (2010) and use the model $ZScore = \left(ROA + E/A\right) / \sigma_{ROA}$, where ROA is the return on assets of BHC, E/A is the equity to asset ratio and σ_{ROA} is the standard deviation of return on assets.

Next, we identify our independent variables. First, we use the U.S. housing price index (HPI) to examine the first hypothesis – Business Cycle Hypothesis (H1). Then,

we employ the natural log of the total assets of BHCs (Size), Return on Asset (ROA), and Loan Loss Reserves Ratio (LLRR) as another three independent variables. Next, we use the two important indicators showing BHC risk characteristics, i.e. the short-term wholesale funding ratio (STWF) and non-performing loan ratio (NPLR), as control variables in our testing of the second hypothesis – Risk Characteristic Hypothesis (H2). In addition, we use the three alternative capital requirements, i.e. the Tier 1 risk-based capital ratio (Tier1), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV), to examine the third hypothesis (H3). Finally, we employ the two alternative measures of BHC activity diversification, i.e. the non-interest income ratio (NIN), and off-balance-sheet activity risk ratio (OBSA), to test the fourth hypothesis (H4).

Finally, a random effects panel regression with standard errors clustered on firm level is used to evaluate the respective determinants of the DD and Z-Score measures. The empirical model is specified in the following equation:

$$DD_{i,t} \text{ or } ZScore_{i,t} = \alpha_{i,t} + \beta_1 * HPI_{i,t} + \beta_2 * Size_{i,t} + \beta_3 * ROA_{i,t} + \beta_4 * STWF_{i,t} + \beta_5 * NPLR_{i,t} + \beta_6 * H3_{i,t} + \beta_7 * H4_{i,t} + \varepsilon_{i,t} \quad (7)$$

where i denotes the bank and t shows the period.

IV DATA AND DESCRIPTIVE STATISTICS

A. Data and Variable Definitions

Our sample selection procedure is as follows. We first select the 2900 U.S. bank holding companies with total assets available for the period from 2003 to 2012, as

listed in the FR Y-9C form[4], the quarterly report BHCs file to the regulatory authorities. From these 2900 BHCs, we delete those that are private companies or are missing important data, which leaves a total of 629 BHCs with 15503 observations, i.e. BHC-quarters. The final sample is from 2003Q1 to 2013Q4, based on which we evaluate our empirical model before, during, and after the recent global financial crisis. Specifically, we follow Berger and Bouwman's (2013) formal definition of the recent 2007-2009 financial crisis. As a result, our sample is divided into three periods: before the crisis, i.e. 2003Q1-2007Q2; during the crisis, i.e. 2007Q3-2009Q4; and after the crisis, i.e. 2010Q1-2013Q4. We estimate our empirical model on each of these periods separately.

To calculate the DD measure, we download the daily share prices of our selected BHCs from 2003 to 2012 from the Center for Research in Security Prices (CRSP) database, the yearly debt data for that period from Compustat, and the daily risk-free rate over the same period from the website of the Federal Reserve Bank of St Louis. To calculate Z-Score, we follow Čihák et al. (2012) and calculate the standard deviation of ROA σ_{ROA} based on a five-quarter rolling time window to allow for sufficient variation in the denominator of Z-Score, in order to avoid the situation whereby the values of Z-Score are derived exclusively from variation in the levels of capital and profitability. Our BHC data based on FR Y-9C are downloaded from the

[4] FR Y-9C is a regulatory report showing Consolidated Financial Statements of Bank Holding Companies. Our BHC database based on FR Y-9C is downloaded from the website of the Federal Reserve Bank of Chicago, available at http://www.chicagofed.org/webpages/banking/financial_institution_reports/bhc_data.cfm

official website of the Federal Reserve Bank of Chicago. Our data on institutional ownership comes from 13-F forms filed with the SEC by each institutional investor.

Table 1 shows the variables used and their construction. All variables except Housing Price Index, Institutional Shareholder Percentage, Distance-to-Default, and Z-Score are obtained from FR Y-9C forms. In the table, the symbol within the brackets after each variable corresponds to the symbol shown in the regression results.

<Table 1 here>

B. Descriptive Statistics

Table 2 displays the descriptive statistics of all variables for our selected BHCs during the periods: 2003Q1-2013Q4, 2003Q1-2007Q2, 2007Q2-2009Q4 and 2010Q1-2013Q4. All descriptive results are expressed in percentage, except Observations, DD, Z-Score, and Size. We can see from this table that before the financial crisis, i.e. from 2003Q1 to 2007Q2, the maximum value of DD is 166.296, the mean is 15.974, and the median is 14.333; while during the crisis, i.e. from 2007Q2 to 2009Q4, the maximum value of DD is 64.355, the mean is only 5.405, and the median is only 4.430. After the crisis, i.e. 2010Q1-2013Q4, the maximum value of DD has surged to 334.412, the mean value has gone back to 10.753, and the median is 9.204. The sharp decrease in various values of DD from 2007Q2 to 2009Q4 indicates that the selected BHCs as a whole suffered drastically during the crisis. However, compared to DD, the values of Z-Score are much more stable before, during and after the crisis. The statistics of housing price index (HPI) in the three selected periods are highly related to those of DD. Table 2 also shows that the selected BHCs have

relatively stable size before, during and after the crisis. More interestingly, the maximum values of the three regulatory capital ratios during the crisis are generally higher than those before and after the crisis, whereas the mean and median values remain stable before, during and after the crisis.

<Table 2 here>

Table 3 illustrates the Correlation Matrix among all the dependent and independent variables used for our selected BHCs during the period 2003Q1-2013Q4. We can see from this table that DD is slightly positively related to its alternative measure Z-Score. Meanwhile, both DD and Z-Score are positively related to both the housing price index (HPI) and the three regulatory capital ratios, i.e. Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV); whereas both DD and Z-Score are negatively related to Size and the two BHC risk characteristics, i.e. the short-term wholesale funding ratio (STWF), and the non-performing loan ratio (NPLR). For the two alternative measures of BHC activity diversification, i.e. the non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA), DD is positively related to the first and negatively related to the second, while Z-Score is positively associated with both. Institutional shareholding (INST) is slightly negatively related to DD but positively related to Z-Score. In addition, OBSA is positively related to STWF, but slightly negatively related to NPLR. Tier I is highly positively associated with the other two alternative capital requirements, i.e. TRBCR and LEV.

<Table 3 here>

V EMPIRICAL RESULTS

A. Multivariate Regression Results

In this section, we derive the multivariate regression results for the determinants of both the DD and Z-Score measures predicting financial distress of the selected BHCs before, during and after the recent financial crisis. Table 4 shows the multivariate regression results before the crisis, i.e. from 2003Q1 to 2007Q2. First, for the DD measure, six multivariate regressions are conducted with the three alternative measures of regulatory capital requirements and the two alternatives of BHC activity diversification. From column 1 to column 3, in addition to our six control variables, we hold the non-interest income ratio (NIN), and run the regressions by changing the three alternatives of regulatory capital requirements. From column 4 to column 6, we hold the off-balance-sheet activity ratio (OBSA) and perform the same steps as for the first three columns. Second, for the Z-Score measure, we implement the same steps as conducted for the DD measure. The results of Z-Score are shown from column 7 to column 12.

As can be seen from the results in columns 1 to 12 in Table 4, some variables, such as the housing price index (HPI), short-term wholesale funding (STWF), and non-performing loan ratio (NPLR), are statistically significant in all regressions, showing that HPI has a strongly positive link with the DD and Z-Score measures, while STWF and NPLR have strongly negative association with both the DD and Z-Score measures, as we expected. The statistic results of Size indicate that there exists a positive size effect on DD but a negative effect on Z-Score. The return on

assets (ROA) variable is significantly positively related to DD but shows no significant relationship with Z-Score. Loan Loss Reserves Ratio (LLRR) has a positive relation with both DD and Z-Score, but this relation is not statistically significant. Comparing the results of the three alternative regulatory capital requirements, we can see that Tier I leverage ratio is a more reliable indicator than the other two. For the two alternative measures of BHC activity diversification, both NIN and OBSA are statistically significant in the results from columns 7 to 12, showing their negative linkage with Z-Score, but they are not significantly related to the DD measure.

<Table 4 here>

Using the same steps as in Table 4, Tables 5 and 6 report the multivariate regression results during the crisis, i.e. 2007Q3-2009Q4, and after the crisis, i.e. 2010Q1-2013Q4, respectively. During the crisis, Table 5 shows that ROA is statistically significant in all regression results, indicating that it has a strongly positive relation with both DD and Z-Score. The significant positive relation between NPLR and both DD and Z-Score illustrates that, as a risk characteristic of BHC, it is still a reliable indicator predicting financial distress. LLRR is only significantly positively related to the DD measure. More interestingly, NIN is significantly positively related to DD during the crisis, but significantly negatively related to Z-Score. Table 5 also indicates that OBSA is not significantly related to either DD or Z-Score, and that Tier I Leverage Ratio and Tier 1 Risk-Based Capital Ratio are

relatively more reliable indicators when we use DD as the predictor of financial distress.

<Table 5 here>

After the crisis, i.e. 2010Q1-2013Q4, Table 6 shows that HPI, as a measure of macroeconomic environment, is a reliable indicator predicting financial distress. ROA is only significantly positively related to Z-Score. NPLR is always a reliable predictor of financial distress. Contrary to its relation with DD during the crisis, LLRR is significantly negatively related to DD after the crisis. For the two alternative measures of BHC activity diversification, only OBSA is significantly negatively related to DD, while only NIN is significantly negatively related to Z-Score. All three regulatory capital requirements are significantly positively related to both DD and Z-Score, showing their strong regulatory strength after the crisis.

<Table 6 here>

B. Additional Analysis

In this part, we conduct a robustness test as our additional analysis by adding an important corporate governance variable, i.e. institutional ownership/shareholdings. Recent literature has suggested that corporate governance plays an important role in bank risk. For example, Laeven and Levine (2009) empirically assess theories concerning risk taking by banks, their ownership structures, and national bank regulations, and suggest that banks with more powerful, diversified owners tend to be riskier than those banks. Pathan (2009) suggests that bank board structure is a vital determinant of bank risk taking, finding that strong bank boards are positively related

to bank risk taking. Erkens, Huang and Matos (2012) find international evidence that banks with more independent boards and higher institutional ownership had worse stock returns during the 2007-08 crisis period. Beltratti and Stulz (2012) find that banks with more shareholder-friendly board structures, i.e. with good governance, experienced drastically worse effects during the 2007-08 crisis compared with other banks. Berger, Imbierowicz and Rauch (2014) investigate the roles of corporate governance in bank defaults during the recent financial crisis, finding that shareholdings of lower-level management such as vice presidents are strongly positively related to bank default risk, whereas shareholdings of outside directors and chief officers do not have a direct effect on bank default risk.

For the relationship between institutional ownership and bank risk, Saunders et al. (1990) suggest that banks with larger institutional shareholdings tend to take on higher risks. Laeven and Levine (2009) and Ellul and Yerramilli (2013) also find that there is a significant positive relationship between institutional ownership and multiple risk measures.

We add the institutional ownership variable into the econometric model (7) to conduct our additional analysis before, during and after the recent financial crisis. Table 7 shows additional analysis results before the crisis. Comparing Table 4 and Table 7, the performances of HPI, ROA, STWF, NPLR, LLRR and NIN remain the same after the addition of institutional ownership. Also, according to the additional analysis results, Tier I Leverage Ratio is still the most reliable indicator among the

three regulatory capital requirements. The institutional ownership variable has a negative relation with both DD and Z-Score, but this relation is not significant.

<Table 7 here>

Table 8 reports additional analysis results for the period during the crisis. Comparing Table 5 and Table 8, the addition of institutional ownership enhances the negative effect of Size on Z-Score, the positive effect of OBSA on DD, and the positive effect of TRBCR on DD, but only weakens the negative effect of STWF on Z-Score. Table 8 also shows that there is a strongly positive relationship between institutional ownership and both DD and Z-Score during the crisis period. One possible interpretation of this positive relation is that institutional shareholders are always prudent and reluctant to take more risk during periods of crisis; therefore, if they are willing to hold more shareholdings of a certain BHC, this risk-taking action seems to indicate that these institutional shareholders believe the BHC they have invested in has better financial stability.

<Table 8 here>

Table 9 reports the additional analysis results for the period after the crisis. Comparing Table 6 and Table 9, the addition of institutional ownership only weakens the negative effect of STWF on Z-Score. Institutional ownership is negatively related with both DD and Z-Score, but this relation is still not significant after the crisis.

<Table 9 here>

C. Possible Policy Implications from our Results

Based on our empirical results from conducting both the main tests and the additional analysis for the periods before, during and after the recent financial crisis, we can identify several implications for financial regulation. First, the housing prices index (HPI) is a reliable indicator of macro-prudential risk, which is in line with the expectation of our first hypothesis (H1). As a result, HPI is an important factor that should be considered by monetary policy and macro-prudential policy, as shown in Blundell-Wignall and Roulet (2012). Therefore, soundness of macroeconomic environment is helpful for promoting financial stability.

Second, in response to our second hypothesis (H2) by investigating the two important BHC risk characteristics, our empirical results show that the non-performing loan ratio (NPLR) is the most powerful indicator of default/insolvency risk among all the selected independent variables. This implies that it is vital for banks or BHCs to carry out internal consolidation to improve their asset quality to avoid possible default/insolvency risk. However, the Dodd-Frank Act of 2010, the latest financial sector regulation established after the recent crisis, does not formulate any provision on how to efficiently manage non-performing loans. Therefore, it seems that related policy actions are called for in the future. On the other hand, short-term wholesale funding (STWF), a variable strongly related to interconnectedness and liquidity risk exposure, can be considered a reliable default risk indicator, particularly when using DD to predict financial distress. Acharya and Richardson (2012) and Greenwood and Scharfstein (2013) suggest that STWF is an important factor reflecting shadow banking and systemic risk. Acharya and

Richardson (2012) further argue that, although some provisions within the Dodd-Frank Act relate to shadow banking, overall the Act does not efficiently address how to regulate the shadow banking sector.

Third, with regard to activity diversification risk, our two diversity measures do not show the same effect on determining default risk, which responses our fourth hypothesis (H4). When using Z-Score to predict financial distress, non-interest income (NIN) has a directly positive effect on insolvency risk within all selected periods, which is consistent with the prediction of studies such as Stiroh (2004) and Stiroh and Rumble (2006). When using DD as dependent variable, we find the negative effect of NIN on default risk only during the crisis time, which is contrary to the prediction of previous studies. However, recent studies such as Köhler (2013) indicate that the impact of NIN on risk hinges on the business mode of a bank. Specifically, Köhler (2013) suggests that banks with a retail-oriented business mode become significantly more stable with the increase in their share of NIN; whereas investment-oriented banks become significantly less stable. Thus, it seems from our results that the positive relationship between NIN and DD during the crisis shows the complexity of our examined BHCs. On the other hand, off-balance-sheet activity (OBSA) as a potential factor for detecting bank default risk does not perform consistently within our selected periods. OBSA has a directly negative impact on Z-Score only before the crisis, while it has a negative impact on DD after the crisis, and no impact on either DD or Z-Score during the crisis. However, based on their 14 OECD-country evidence, Karim et al. (2013) suggest that OBSA contributed

significantly to the probability of crisis after 2003. Indeed, the Dodd-Frank Act considers the diversified activities of banks or BHCs. For example, the Act calls for more stringent prudential standards for systemically important financial institutions (SIFIs), by considering additional standards based on the off-balance-sheet exposures of banks or BHCs (Acharya and Richardson, 2012).

Fourth, for regulatory capital requirements, we obtain an interesting result. All three measures of capital requirements have a directly positive impact on both DD and Z-Score only after the crisis, i.e. 2010Q1-2013Q4, which is in accordance with the prediction of our third hypothesis (H3). This significant result seems to be consistent with the related policy actions after the crisis. For example, in 2010-2011 the Basel Committee on Banking Supervision introduced the Basel III regulations, in which both capital requirements and leverage ratio have been updated to be more stringent. The Dodd-Frank Act of 2010 also enhanced capital requirements for SIFIs. However, there is ongoing debate as to whether capital requirements alone are the best tool for managing systemic risk for financial institutions. For example, while studies such as Admati et al. (2010) and Duffie (2012) suggest that only capital requirements can manage the systemic risk of banks, Acharya and Richardson (2012) imply that both capital requirements and restrictions on asset holdings (e.g. using the Volcker rule within the Dodd-Frank Act) can effectively manage the systemic risk of financial institutions.

VI Conclusions

In this paper, we use a sample of 629 bank holding companies in the U.S. to probe the impact of various factors on the financial distress of BHCs, before, during and after the recent financial crisis. Our main findings are: First, the housing price index is consistently significant and is positively associated with the DD and the Z-Score measures. Second, the non-performing loan ratio is the most powerful indicator predicting financial distress, and short-term wholesale funding can also be considered a reliable default risk indicator. Third, although existing studies have shown that the two alternative measures of BHC activity diversification are very important factors affecting default risk, in this study no conclusive findings have been reached regarding their role as determinants of default risk. Fourth, all three measures of regulatory capital requirements have a directly positive impact on both DD and Z-Score from 2010Q1 to 2013Q4, showing their importance in the post-crisis period.

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Table 1 Variable Names and Construction

Variable	FR Y-9C Data Item or Sources
Alternative Regulatory Captial	
Tier I Leverage Ratio (T1Lev)	BHCK7204
Tier I Risk-Based Capital Ratio (T1Cap)	BHCK7206
Total Risk-Based Capital Ratio (TRBCR)	BHCK7205
Alternative Bank Activity Diversification	
Non Interest Income Ratio (NIN)	BHCK4079/(BHCK4079+BHCK4107)
Off-Balance Sheet Activity Ratio (OSBA)	(BHCK3809+BHCK8766+BHCK8767)/BHCK2170
Control Variables	
House Price Index (HPI)	All-Transactions House Price Index for the United States, downloaded from http://research.stlouisfed.org/fred2/series/USSTHPI/
Size (Size)	ln(BHCK2170)
Return on Assets (ROA)	BHCK4340/BHCK2170
Short-Term Wholesale Funding (STWF)	(BHCK2309+BHCK3353+BHCK2332+BHDMA243)/BHCK2170
Non-Performing Loan Ratio (NPLR)	(BHCK5525+BHCK5526)/BHCK2170*100
Loan Loss Reserve Ratio (LLRR)	BHCK4230/BHCK3516
Institutional Shareholding (INST)	Institutional shareholding calculated from 13F
Dependent Variable	
Distance-to-Default (DD)	Derived from equations from (1) to (6)
Z-Score (ZScore)	(ROA+BHCK3210/BHCK2170)/sd(ROA)

Notes: The listed variables are used in our empirical study. All variables except the Housing Price Index, Institutional Shareholder Percentage, Distance-to-Default, and Z-Score are taken from FR Y-9C forms. FR Y-9C is a regulatory report showing Consolidated Financial Statements of Bank Holding Companies. Our BHC data based on FR Y-9C are downloaded from the official website of the Federal Reserve Bank of Chicago. Our data on institutional ownership comes from 13-F forms filed by each institutional investors with the SEC. The symbol within the brackets after each variable corresponds to the symbol shown in the regression results.

Table 2 Descriptive Statistics

Variable	DD	ZScore	HPI	Size	ROA	STWF	NPLR	LLRR	NIN	OSBA	T1Lev	T1Cap	TRBCR	INST
	2003Q1 - 2013Q4													
Obs	15503	15503	15503	15503	15503	15503	15503	15503	15503	15503	15503	15503	15503	13899
Mean	12.180	3.392	0.577	14.672	0.004	0.082	0.012	0.005	0.187	0.291	9.527	12.857	14.448	0.315
Std. Dev.	9.44	0.80	1.73	1.64	0.01	0.08	0.02	0.01	0.14	2.57	7.51	9.07	10.95	0.24
Min	-2.730	-4.758	-3.072	11.940	-0.085	0.000	0.000	-0.024	-1.839	0.000	-3.510	-2.660	-2.660	0.000
Median	10.872	3.430	0.851	14.261	0.004	0.062	0.006	0.002	0.160	0.000	8.960	11.790	13.320	0.255
Max	334.412	7.351	3.810	21.594	0.194	0.706	0.192	0.201	0.993	52.720	793.000	843.000	1155.000	3.461
	2003Q1 - 2007Q2													
Obs	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	6721
Mean	15.974	3.403	1.909	14.434	0.006	0.079	0.005	0.002	0.185	0.179	9.271	12.545	14.094	0.259
Std. Dev.	8.883	0.456	0.892	1.601	0.006	0.076	0.006	0.003	0.125	1.659	4.260	6.717	6.586	0.213
Min	-0.977	-1.004	0.382	11.940	-0.029	0.000	0.000	-0.015	-0.080	0.000	1.820	2.650	5.290	0.000
Median	14.333	3.353	1.602	14.008	0.006	0.060	0.003	0.001	0.158	0.000	8.690	11.380	12.850	0.197
Max	166.296	6.066	3.810	21.427	0.142	0.672	0.092	0.053	0.977	38.330	83.010	150.550	150.610	1.137
	2007Q3 - 2009Q4													
Obs	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3154
Mean	5.405	3.194	-1.263	14.826	0.001	0.109	0.017	0.008	0.171	0.295	9.516	11.968	13.631	0.328
Std. Dev.	5.086	1.077	1.240	1.570	0.012	0.086	0.018	0.011	0.128	2.602	13.866	15.174	20.112	0.242
Min	-2.730	-4.758	-3.072	12.321	-0.085	0.000	0.000	-0.006	-0.205	0.000	-3.510	-2.660	-2.660	0.000
Median	4.430	3.397	-0.877	14.402	0.003	0.089	0.011	0.004	0.146	0.002	8.860	10.930	12.500	0.272
Max	64.355	5.951	0.763	21.581	0.194	0.700	0.192	0.169	0.980	44.854	793.000	843.000	1155.000	1.935
	2010Q1 - 2013Q4													
Obs	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4024
Mean	10.753	3.536	-0.368	14.984	0.003	0.065	0.022	0.006	0.205	0.496	10.009	14.165	15.777	0.398
Std. Dev.	9.666	0.972	1.139	1.691	0.009	0.068	0.019	0.009	0.157	3.676	3.885	5.136	4.945	0.266
Min	-1.417	-4.398	-2.755	12.473	-0.065	0.000	0.000	-0.024	-1.839	0.000	-0.240	-0.380	-0.380	0.000
Median	9.204	3.660	-0.691	14.525	0.003	0.047	0.017	0.004	0.181	0.007	9.580	13.410	15.040	0.379
Max	334.412	7.351	1.297	21.594	0.143	0.706	0.142	0.201	0.993	52.720	71.130	97.740	97.870	3.461

Notes: This table shows the descriptive statistics of all dependent and independent variables for our selected BHCs, during the periods: 2003Q1-2013Q4, 2003Q1-2007Q2, 2007Q3-2009Q4, and 2010Q1-2013Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding

(STWF), the non-performing loan ratio (NPLR), loan loss reserve ratio (LLRR) and institutional Shareholding (INST) are the seven control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. All descriptive results are expressed in percentage, except Observations (Obs), DD, Z-Score and Size.

Table 3 Correlation between Variables during the Selected Full Period

	Correlation Matrix													
	DD	**ZScore**	**HPI**	**Size**	**ROA**	**STWF**	**NPLR**	**LLRR**	**NIN**	**OSBA**	**T1Lev**	**T1Cap**	**TRBCR**	**INST**
DD	1.000													
ZScore	0.104	1.000												
HPI	0.385	0.034	1.000											
Size	-0.009	-0.033	-0.110	1.000										
ROA	0.272	0.285	0.236	0.081	1.000									
STWF	-0.235	-0.096	-0.078	0.294	-0.037	1.000								
NPLR	-0.302	-0.263	-0.410	0.017	-0.395	-0.004	1.000							
LLRR	-0.259	-0.265	-0.346	0.108	-0.393	0.063	0.490	1.000						
NIN	0.099	0.012	0.009	0.511	0.326	0.109	-0.118	-0.011	1.000					
OSBA	-0.037	0.030	-0.030	0.369	-0.001	0.209	-0.028	0.024	0.262	1.000				
T1Lev	0.060	0.065	-0.017	-0.050	0.216	-0.074	-0.013	0.015	0.125	-0.035	1.000			
T1Cap	0.085	0.099	-0.005	-0.059	0.257	-0.067	-0.032	-0.004	0.172	-0.011	0.952	1.000		
TRBCR	0.064	0.072	-0.008	-0.010	0.205	-0.046	-0.016	0.008	0.157	0.003	0.970	0.983	1.000	
INST	-0.002	0.042	-0.152	0.693	0.064	0.179	0.020	0.099	0.363	0.147	0.032	0.035	0.051	1.000

Notes: This table shows correlation matrix of all dependent and independent variables for our selected BHCs during the period 2003Q1-2013Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), loan loss reserve ratio (LLRR) and institutional Shareholding (INST) are the seven control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements.

Table 4 Multivariate Regression Results before the Financial Crisis

	2003Q1 - 2007Q2											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.667	0.663	0.663	0.665	0.660	0.659	0.059	0.058	0.058	0.060	0.059	0.059
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Size	0.370	0.334	0.299	0.377	0.352	0.323	-0.024	-0.028	-0.030	-0.033	-0.037	-0.038
	[0.024]**	[0.043]**	[0.065]*	[0.012]**	[0.019]**	[0.029]**	[0.094]*	[0.046]**	[0.032]**	[0.010]***	[0.004]***	[0.003]***
ROA	86.475	90.535	92.268	88.517	93.105	95.151	1.460	1.808	1.926	0.654	1.046	1.170
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.534]	[0.435]	[0.406]	[0.784]	[0.656]	[0.619]
STWF	-28.544	-29.080	-29.053	-28.494	-29.029	-28.990	-0.507	-0.542	-0.540	-0.547	-0.572	-0.570
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.005]***	[0.003]***	[0.003]***	[0.006]***	[0.004]***	[0.004]***
NPLR	-77.374	-77.907	-78.659	-76.970	-77.471	-78.251	-13.149	-13.241	-13.307	-13.290	-13.376	-13.427
	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.001]***	[0.005]***	[0.005]***	[0.005]***	[0.005]***	[0.005]***	[0.005]***
LLRR	7.257	7.717	6.981	7.028	7.484	6.698	6.972	6.921	6.867	7.102	7.014	6.959
	[0.865]	[0.857]	[0.870]	[0.869]	[0.861]	[0.876]	[0.182]	[0.182]	[0.186]	[0.173]	[0.175]	[0.178]
NIN	1.126	1.455	1.637				-0.550	-0.517	-0.505			
	[0.554]	[0.452]	[0.399]				[0.005]***	[0.008]***	[0.010]***			
OSBA				0.109	0.108	0.107				-0.028	-0.027	-0.028
				[0.385]	[0.391]	[0.392]				[0.062]*	[0.063]*	[0.061]*
T1Lev	0.170			0.176			0.014			0.011		
	[0.031]**			[0.025]**			[0.019]**			[0.075]*		
T1Cap		0.075			0.080			0.005			0.004	
		[0.111]			[0.087]*			[0.155]			[0.359]	
TRBCR			0.061			0.066			0.004			0.003
			[0.173]			[0.135]			[0.260]			[0.497]
_cons	9.437	10.491	11.023	9.479	10.421	10.903	3.721	3.838	3.872	3.779	3.885	3.909
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801	7801
N of groups	567	567	567	567	567	567	567	567	567	567	567	567
within	0.031	0.030	0.030	0.031	0.030	0.030	0.052	0.048	0.048	0.053	0.049	0.049
between	0.175	0.178	0.177	0.174	0.177	0.176	0.111	0.116	0.114	0.056	0.062	0.061
overall	0.107	0.108	0.108	0.106	0.107	0.107	0.085	0.083	0.080	0.058	0.056	0.054
Wald chi2	244.43	234.68	236.29	240.82	231.65	233.26	539.82	536.87	536.33	541.72	540.34	540.81
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows the multivariate regression results by using the econometric equation (7) (random effects model with standard errors clustered on firm level) for the determinants of both the DD and Z-Score measures based on the selected BHCs before the crisis, i.e. 2003Q1-2007Q2. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), and loan loss reserve ratio (LLRR) are the six control variables, in which STWF and NPLR show the

BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5 Multivariate Regression Results during the Financial Crisis

	2007Q3 - 2009Q4											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.126	0.126	0.126	0.131	0.130	0.131	0.026	0.026	0.026	0.027	0.027	0.027
	[0.022]**	[0.023]**	[0.022]**	[0.018]**	[0.019]**	[0.018]**	[0.096]*	[0.094]*	[0.096]*	[0.103]	[0.100]*	[0.103]
Size	-0.449	-0.446	-0.449	-0.215	-0.213	-0.216	0.031	0.031	0.031	-0.029	-0.029	-0.029
	[0.000]***	[0.000]***	[0.000]***	[0.051]*	[0.053]*	[0.050]**	[0.220]	[0.222]	[0.220]	[0.169]	[0.165]	[0.172]
ROA	38.019	38.040	38.077	47.978	47.988	48.058	49.354	49.376	49.361	47.173	47.203	47.177
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
STWF	-11.319	-11.320	-11.323	-11.723	-11.726	-11.729	-0.638	-0.638	-0.638	-0.558	-0.559	-0.558
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.069]*	[0.068]*	[0.068]*	[0.116]	[0.116]	[0.116]
NPLR	-49.113	-49.061	-49.140	-49.921	-49.878	-49.966	-16.508	-16.518	-16.511	-16.000	-16.015	-16.003
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
LLRR	27.983	27.824	27.939	32.735	32.551	32.695	-0.676	-0.647	-0.659	-1.533	-1.501	-1.520
	[0.014]**	[0.015]**	[0.014]**	[0.006]***	[0.006]***	[0.006]***	[0.915]	[0.918]	[0.917]	[0.817]	[0.819]	[0.818]
NIN	7.063	7.031	7.057				-1.369	-1.364	-1.367			
	[0.000]***	[0.000]***	[0.000]***				[0.000]***	[0.000]***	[0.000]***			
OSBA				0.051	0.051	0.051				0.010	0.010	0.010
				[0.106]	[0.108]	[0.108]				[0.522]	[0.517]	[0.518]
T1Lev	0.004			0.005			-0.001			-0.001		
	[0.033]**			[0.087]*			[0.224]			[0.203]		
T1Cap		0.005			0.006			-0.001			-0.001	
		[0.092]*			[0.140]			[0.302]			[0.253]	
TRBCR			0.003			0.003			-0.001			-0.001
			[0.043]**			[0.091]*			[0.140]			[0.135]
_cons	15.007	14.948	15.013	12.586	12.525	12.590	3.205	3.210	3.204	3.891	3.897	3.889
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479	3479
N of groups	418	418	418	418	418	418	418	418	418	418	418	418
within	0.222	0.222	0.222	0.216	0.216	0.216	0.312	0.312	0.312	0.313	0.313	0.313
between	0.277	0.279	0.278	0.285	0.288	0.286	0.332	0.332	0.332	0.294	0.294	0.294
overall	0.252	0.253	0.253	0.241	0.242	0.241	0.299	0.300	0.299	0.279	0.280	0.280
Wald chi2	590.25	581.04	582.56	560.40	551.37	552.78	492.02	495.24	499.97	508.89	471.37	472.41
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows the multivariate regression results by using the econometric equation (7) (random effects model with standard errors clustered on firm level) for the determinants of both the DD and Z-Score measures based on the selected BHCs during the crisis, i.e. 2007Q3-2009Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), and loan loss reserve ratio (LLRR) are the six control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio

(TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6 Multivariate Regression Results after the Financial Crisis

	2010Q1 - 2013Q4											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.199	0.183	0.189	0.197	0.181	0.187	0.072	0.069	0.070	0.073	0.070	0.071
	[0.060]*	[0.087]*	[0.075]*	[0.061]*	[0.088]*	[0.076]*	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Size	0.807	0.798	0.729	0.985	0.996	0.934	0.037	0.036	0.026	0.011	0.013	0.005
	[0.000]***	[0.001]***	[0.001]***	[0.000]***	[0.000]***	[0.000]***	[0.198]	[0.176]	[0.315]	[0.696]	[0.622]	[0.860]
ROA	-7.572	3.567	6.303	-5.484	5.163	8.161	20.310	21.936	22.240	18.868	20.395	20.702
	[0.742]	[0.854]	[0.751]	[0.800]	[0.769]	[0.649]	[0.001]***	[0.000]***	[0.000]***	[0.001]***	[0.000]***	[0.000]***
STWF	-11.730	-13.203	-13.247	-11.297	-12.658	-12.695	-0.681	-0.867	-0.861	-0.671	-0.842	-0.834
	[0.001]***	[0.000]***	[0.000]***	[0.001]***	[0.000]***	[0.000]***	[0.140]	[0.047]**	[0.048]**	[0.150]	[0.055]*	[0.058]*
NPLR	-44.428	-44.803	-47.136	-45.422	-45.894	-48.251	-11.416	-11.503	-11.765	-11.335	-11.442	-11.703
	[0.032]**	[0.028]**	[0.023]**	[0.028]**	[0.024]**	[0.020]**	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
LLRR	-51.629	-47.440	-47.775	-51.740	-47.696	-48.014	-4.591	-3.938	-4.028	-4.722	-4.102	-4.191
	[0.003]***	[0.009]***	[0.007]***	[0.003]***	[0.008]***	[0.006]***	[0.129]	[0.182]	[0.168]	[0.113]	[0.159]	[0.147]
NIN	0.907	0.818	0.905				-0.486	-0.499	-0.495			
	[0.603]	[0.651]	[0.615]				[0.053]*	[0.043]**	[0.046]**			
OSBA				-0.173	-0.203	-0.207				0.006	0.002	0.002
				[0.002]***	[0.000]***	[0.000]***				[0.352]	[0.716]	[0.810]
T1Lev	0.474			0.476			0.076			0.075		
	[0.000]***			[0.000]***			[0.004]***			[0.005]***		
T1Cap		0.340			0.344			0.055			0.054	
		[0.000]***			[0.000]***			[0.000]***			[0.000]***	
TRBCR			0.315			0.319			0.055			0.054
			[0.001]***			[0.001]***			[0.000]***			[0.000]***
_cons	-5.406	-5.199	-4.335	-7.825	-7.968	-7.188	2.584	2.598	2.660	2.883	2.857	2.905
	[0.140]	[0.184]	[0.260]	[0.024]**	[0.032]**	[0.048]**	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223	4223
N of groups	370	370	370	370	370	370	370	370	370	370	370	370
within	0.166	0.164	0.163	0.166	0.163	0.162	0.165	0.168	0.167	0.163	0.166	0.164
between	0.196	0.250	0.245	0.201	0.258	0.253	0.317	0.362	0.361	0.312	0.357	0.356
overall	0.189	0.207	0.203	0.195	0.215	0.211	0.152	0.177	0.177	0.149	0.173	0.173
Wald chi2	727.99	699.08	696.11	717.55	691.05	689.76	348.11	353.83	357.59	343.67	349.08	352.21
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows the multivariate regression results by using the econometric equation (7) (random effects model with standard errors clustered on firm level) for the determinants of both the DD and Z-Score measures based on the selected BHCs after the crisis, i.e. 2010Q1-2013Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size), return on

assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), and loan loss reserve ratio (LLRR) are the six control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7 Additional Analysis Results before the Financial Crisis

	2003Q1 - 2007Q2											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.585	0.580	0.578	0.582	0.576	0.574	0.055	0.054	0.054	0.055	0.055	0.055
	[0.001]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Size	0.597	0.540	0.510	0.636	0.592	0.568	-0.024	-0.028	-0.030	-0.036	-0.040	-0.041
	[0.006]***	[0.014]**	[0.019]**	[0.002]***	[0.004]***	[0.006]***	[0.207]	[0.137]	[0.111]	[0.040]**	[0.020]**	[0.016]**
ROA	101.973	107.113	109.391	103.505	109.186	111.767	3.253	3.460	3.562	2.591	2.826	2.937
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.178]	[0.146]	[0.134]	[0.289]	[0.239]	[0.220]
STWF	-28.636	-29.045	-29.098	-28.511	-28.893	-28.920	-0.577	-0.603	-0.604	-0.628	-0.648	-0.648
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***	[0.000]***	[0.000]***	[0.001]***	[0.001]***	[0.001]***
NPLR	-72.354	-71.429	-71.718	-72.333	-71.311	-71.614	-8.917	-8.802	-8.841	-8.973	-8.871	-8.903
	[0.044]**	[0.048]**	[0.047]**	[0.044]**	[0.048]**	[0.048]**	[0.083]*	[0.088]*	[0.087]*	[0.082]*	[0.086]*	[0.085]*
LLRR	19.005	18.386	17.679	18.613	17.915	17.126	3.957	3.888	3.856	4.158	4.061	4.031
	[0.689]	[0.700]	[0.712]	[0.695]	[0.708]	[0.721]	[0.439]	[0.444]	[0.449]	[0.417]	[0.425]	[0.429]
NIN	1.049	1.434	1.641				-0.474	-0.456	-0.449			
	[0.628]	[0.515]	[0.458]				[0.039]**	[0.046]**	[0.052]*			
OSBA				-0.007	-0.006	-0.006				-0.014	-0.013	-0.013
				[0.900]	[0.922]	[0.925]				[0.082]*	[0.102]	[0.096]*
T1Lev	0.114			0.119			0.010			0.009		
	[0.081]*			[0.063]*			[0.040]**			[0.127]		
T1Cap		0.032			0.036			0.004			0.003	
		[0.375]			[0.295]			[0.227]			[0.455]	
TRBCR			0.015			0.020			0.003			0.002
			[0.670]			[0.549]			[0.293]			[0.552]
INST	-2.539	-2.347	-2.258	-2.537	-2.344	-2.254	-0.032	-0.018	-0.014	-0.038	-0.024	-0.020
	[0.102]	[0.132]	[0.148]	[0.103]	[0.134]	[0.150]	[0.766]	[0.865]	[0.894]	[0.724]	[0.826]	[0.852]
_cons	7.185	8.498	9.066	6.786	7.972	8.479	3.727	3.824	3.850	3.825	3.923	3.942
	[0.018]**	[0.005]***	[0.002]***	[0.022]**	[0.007]***	[0.003]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	6721	6721	6721	6721	6721	6721	6721	6721	6721	6721	6721	6721
N of groups	504	504	504	504	504	504	504	504	504	504	504	504
within	0.030	0.029	0.029	0.030	0.029	0.029	0.041	0.039	0.039	0.041	0.039	0.039
between	0.159	0.164	0.167	0.159	0.164	0.167	0.080	0.077	0.075	0.050	0.049	0.048
overall	0.104	0.105	0.105	0.103	0.104	0.104	0.062	0.059	0.057	0.044	0.043	0.041
Wald chi2	191.96	190.01	192.45	190.53	188.69	191.23	455.32	456.64	457.06	447.99	451.46	452.80
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows additional analysis results after adding the institutional ownership variable into the econometric model (7) using random effects model with standard errors clustered on firm level for the determinants of both the DD and Z-Score measures based on the selected BHCs before the crisis, i.e. 2003Q1-2007Q2. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent

variables. The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), loan loss reserve ratio (LLRR) and institutional Shareholding (INST) are the seven control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8 Additional Analysis Results during the Financial Crisis

	2007Q3 - 2009Q4											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.110	0.110	0.110	0.117	0.116	0.117	0.029	0.029	0.029	0.029	0.029	0.029
	[0.060]*	[0.061]*	[0.060]*	[0.048]**	[0.049]**	[0.047]**	[0.087]*	[0.085]*	[0.087]*	[0.102]	[0.100]*	[0.102]
Size	-0.698	-0.694	-0.698	-0.479	-0.475	-0.479	-0.042	-0.042	-0.042	-0.123	-0.124	-0.123
	[0.000]***	[0.000]***	[0.000]***	[0.001]***	[0.002]***	[0.001]***	[0.232]	[0.227]	[0.233]	[0.000]***	[0.000]***	[0.000]***
ROA	36.594	36.600	36.639	47.004	46.999	47.069	48.281	48.304	48.287	45.702	45.744	45.710
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
STWF	-12.050	-12.053	-12.054	-12.343	-12.348	-12.349	-0.516	-0.517	-0.516	-0.458	-0.460	-0.458
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.186]	[0.185]	[0.185]	[0.256]	[0.254]	[0.255]
NPLR	-49.682	-49.639	-49.703	-50.368	-50.332	-50.406	-15.808	-15.818	-15.810	-15.116	-15.135	-15.120
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
LLRR	24.750	24.628	24.717	29.749	29.606	29.722	-0.940	-0.911	-0.925	-2.066	-2.025	-2.051
	[0.042]**	[0.043]**	[0.042]**	[0.020]**	[0.020]**	[0.020]**	[0.887]	[0.890]	[0.889]	[0.766]	[0.770]	[0.768]
NIN	7.383	7.356	7.378				-1.568	-1.562	-1.566			
	[0.000]***	[0.000]***	[0.000]***				[0.000]***	[0.000]***	[0.000]***			
OSBA				0.070	0.069	0.070				0.016	0.016	0.016
				[0.032]**	[0.032]**	[0.032]**				[0.325]	[0.321]	[0.322]
T1Lev	0.004			0.004			-0.001			-0.001		
	[0.019]**			[0.080]*			[0.108]			[0.115]		
T1Cap		0.005			0.005			-0.001			-0.001	
		[0.077]*			[0.135]			[0.172]			[0.162]	
TRBCR			0.003			0.003			-0.001			-0.001
			[0.032]**			[0.085]*			[0.059]*			[0.075]*
INST	2.412	2.396	2.409	2.689	2.669	2.686	0.820	0.821	0.820	0.864	0.866	0.864
	[0.003]***	[0.003]***	[0.003]***	[0.002]***	[0.002]***	[0.002]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
_cons	17.973	17.906	17.977	15.717	15.642	15.719	4.051	4.059	4.051	5.002	5.012	5.001
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	3154	3154	3154	3154	3154	3154	3154	3154	3154	3154	3154	3154
N of groups	382	382	382	382	382	382	382	382	382	382	382	382
within	0.213	0.213	0.213	0.208	0.208	0.208	0.306	0.306	0.306	0.308	0.308	0.308
between	0.280	0.282	0.281	0.286	0.289	0.287	0.259	0.258	0.258	0.221	0.221	0.221
overall	0.244	0.245	0.244	0.231	0.232	0.232	0.265	0.265	0.265	0.240	0.240	0.240
Wald chi2	515.41	504.31	505.62	498.78	489.73	491.06	506.72	498.03	505.78	490.83	423.92	426.97
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows additional analysis results after adding the institutional ownership variable into the econometric model (7) using random effects model with standard errors clustered on firm level for the determinants of both the DD and Z-Score measures based on the selected BHCs during the crisis, i.e. 2007Q3-2009Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables.

The housing price index (HPI), size (Size), return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), loan loss reserve ratio (LLRR) and institutional Shareholding (INST) are the seven control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9 Additional Analysis Results after the Financial Crisis

	2010Q1 - 2013Q4											
Variable	**DD**	**DD**	**DD**	**DD**	**DD**	**DD**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**	**ZScore**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
HPI	0.205	0.191	0.194	0.203	0.189	0.193	0.073	0.071	0.071	0.074	0.072	0.073
	[0.028]**	[0.045]**	[0.039]**	[0.028]**	[0.044]**	[0.038]**	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Size	1.361	1.353	1.278	1.583	1.598	1.529	0.055	0.058	0.049	0.027	0.032	0.024
	[0.041]**	[0.045]**	[0.053]*	[0.020]**	[0.021]**	[0.024]**	[0.158]	[0.102]	[0.154]	[0.511]	[0.405]	[0.516]
ROA	-9.404	1.601	3.700	-7.962	2.338	4.741	19.389	20.792	21.035	17.591	18.836	19.076
	[0.712]	[0.944]	[0.873]	[0.734]	[0.907]	[0.816]	[0.001]***	[0.000]***	[0.000]***	[0.002]***	[0.000]***	[0.000]***
STWF	-13.122	-13.833	-13.945	-12.531	-13.093	-13.198	-0.428	-0.483	-0.482	-0.401	-0.442	-0.440
	[0.002]***	[0.001]***	[0.001]***	[0.003]***	[0.002]***	[0.002]***	[0.349]	[0.273]	[0.275]	[0.384]	[0.321]	[0.325]
NPLR	-34.968	-35.739	-37.017	-36.173	-37.018	-38.329	-10.008	-10.084	-10.211	-9.851	-9.936	-10.062
	[0.025]**	[0.020]**	[0.016]**	[0.021]**	[0.016]**	[0.013]**	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
LLRR	-48.400	-44.080	-44.651	-48.503	-44.312	-44.850	-6.067	-5.449	-5.536	-6.293	-5.718	-5.803
	[0.008]***	[0.021]**	[0.017]**	[0.008]***	[0.020]**	[0.016]**	[0.056]*	[0.084]*	[0.077]*	[0.042]**	[0.065]*	[0.058]*
NIN	0.767	0.594	0.692				-0.624	-0.653	-0.650			
	[0.729]	[0.796]	[0.763]				[0.021]**	[0.014]**	[0.014]**			
OSBA				-0.210	-0.242	-0.244				0.001	-0.002	-0.003
				[0.008]***	[0.004]***	[0.004]***				[0.836]	[0.739]	[0.656]
T1Lev	0.431			0.433			0.061			0.059		
	[0.000]***			[0.000]***			[0.011]**			[0.017]**		
T1Cap		0.319			0.324			0.047			0.045	
		[0.003]***			[0.003]***			[0.001]***			[0.001]***	
TRBCR			0.294			0.300			0.046			0.045
			[0.005]***			[0.004]***			[0.001]***			[0.001]***
INST	-5.289	-5.289	-5.175	-5.467	-5.506	-5.399	-0.097	-0.125	-0.120	-0.087	-0.116	-0.112
	[0.284]	[0.287]	[0.295]	[0.273]	[0.272]	[0.279]	[0.686]	[0.581]	[0.598]	[0.721]	[0.613]	[0.628]
_cons	-11.194	-11.167	-10.218	-14.225	-14.604	-13.740	2.523	2.450	2.508	2.839	2.734	2.780
	[0.204]	[0.225]	[0.259]	[0.118]	[0.125]	[0.143]	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
N	4024	4024	4024	4024	4024	4024	4024	4024	4024	4024	4024	4024
N of groups	359	359	359	359	359	359	359	359	359	359	359	359
within	0.160	0.157	0.157	0.159	0.157	0.157	0.124	0.128	0.127	0.121	0.124	0.124
between	0.157	0.209	0.201	0.167	0.223	0.214	0.307	0.346	0.346	0.299	0.338	0.338
overall	0.149	0.164	0.159	0.156	0.175	0.169	0.130	0.150	0.150	0.125	0.143	0.142
Wald chi2	741.31	686.14	683.76	741.70	686.20	685.83	331.19	336.14	337.32	308.75	311.37	314.07
Prob > chi2	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: This table shows additional analysis results after adding the institutional ownership variable into the econometric model (7) using random effects model with standard errors clustered on firm level for the determinants of both the DD and Z-Score measures based on the selected BHCs after the crisis, i.e. 2010Q1-2013Q4. The variable construction can be found in Table 1. The DD measure (DD) and the Z-Score measure (ZScore) are the two dependent variables. The housing price index (HPI), size (Size),

return on assets (ROA), short-term wholesale funding (STWF), the non-performing loan ratio (NPLR), loan loss reserve ratio (LLRR) and institutional Shareholding (INST) are the seven control variables, in which STWF and NPLR show the BHC risk characteristics. The non-interest income ratio (NIN) and the off-balance-sheet activity risk ratio (OBSA) are the two alternative measures of BHC activity diversification. The Tier I risk-based capital ratio (Tier I), Total risk-based capital ratio (TRBCR), and Tier I leverage ratio (LEV) are the three alternative measures of capital requirements. *, ** and *** imply statistical significance at the 10%, 5%, and 1% levels, respectively.